MINOUW

Case study results

1.1 Icelandic demersal fishery

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Summary

Exploring the ecological and environmental impacts of discarding in Icelandic Demersal fisheries using modelling techniques.

Case study results

Type of intervention

To explore what effects changed selectivity or discard rate would have on the landings, profit and the ecosystem.

Main activities carried out

An Atlantis model of Icelandic waters was used to explore the effects of changed selectivity or discard rate on the landings and profit of the most important commercial species and on the ecosystem. The model area is 1,600,000 km^2 which was divided into 51 spatial boxes and each box further divided into layers. The model included 52 functional groups: 26 vertebrates where 20 are fish groups, 5 mammals and 1 seabird group, 16 invertebrates, 5 primary producers, 2 bacteria and 3 detritus groups. Fisheries were included in the model as a simple harvest rate for each group that is equal in all areas but is allowed to change between years. The harvest rate is then multiplied with selectivity of each age-class to obtain the catch for the harvested groups. Only discarding of cod and haddock were assumed in the model which were modelled as proportion discarded of each age-class. It was assumed that all discarded fish in the model would die and therefore go into the discard detritus group.

Five different scenarios were compared:

1) Status quo: Historical discard rates.
2) More discards: Scenario where the proportion of each age-class for cod and haddock was increased from the Status quo scenario. In this scenario all cod and haddock from the first two age-classes were discarded and the discard rate was doubled for the other age-classes.
3) No discards: In this scenario no fish were discarded and all caught fish were landed.
4) Improved selectivity: Reduced selectivity on younger fish and no discarding.

Perfect compliance: knife-edged selectivity at the minimum landing size.

Main result

- The results showed that a complete stop of discarding fish, where discard rates were low, and landing everything instead had little ecological and economic impact.
- Improved selectivity, which would result in not catching the fish that would be discarded, resulted in increased biomass and landings of cod and haddock.
- Improved selectivity had also great beneficial economic effects for the cod and haddock fisheries.
- Cost decreased with increasing biomass, which increased the profit of the fisheries.

Discussion of the results

Discarding more fish or landing all fish as in scenarios 2 and 3 did not have much effect on the biomass of the commercial species as the fishing mortality was the same as in the status quo scenario. It also did not have much effect on the landings and profit as the biomass of the discarded fish is low even though their numbers are high.

The increase in landings in scenarios 4 and 5 compared to the status quo scenario was almost as high as the increase in biomass despite the juveniles are targeted less or not at all but they did account for around 10% of the total landings of haddock in the status quo scenario. The positive effects of not fishing juveniles were delayed. It took four years for the first cohort to reach the fishable stock and 20 years to reach the oldest age. Not fishing juveniles also meant larger spawning stock biomass which led to increased number of recruits but the increase did not peak until after more than 20 years when the recruitment was 4.6% and 9.1% higher for cod and haddock, respectively.

The profit from the fisheries was much higher in scenarios 4 and 5 than the landings indicated. The increased biomass resulted in less cost per harvested ton. The cost per ton was as much as 31% less in the haddock fisheries. Not only did the cost decrease but the average fish price increased because older and larger fish were being caught. The average price per kg of haddock was 3% higher in scenario 5 than in the status quo scenario. The combined effects of increased landings, decreased cost and increased price resulted in 24% and 43% higher profit for the haddock fisheries and 5% and 11% higher profit for the cod fisheries in scenarios 4 and 5 than in the status quo scenario.

The changes in biomass of the commercial groups in the scenarios had a slight impact on other groups in the model. The reason for the changes were threefold: 1) the increased biomass in scenarios 4 and 5 caused more feed for the top predators which increased their biomass, 2) the increased biomass of cod and haddock resulted in increased predation mortality of their prey species leading to decreased biomass of those groups, and 3) the changes in the commercial groups had indirect effect on other group, e.g. led to changes in the lower throphic levels (e.g. zooplankton) which cascaded through the food web, causing different fluctuation in biomass of some of the groups, especially the pelagic fish groups.

How practical is it for a fisherman to implement this improvement, technically and financially?

Two of the scenarios explore the effects of improved selectivity, one were discarded fish from the status quo scenario is not caught and another where juveniles are completely avoided. Not fishing any juveniles is a very difficult task if not impossible and makes scenario 5 a utopian scenario but clearly an ideal one as it gave much more profit than the other ones. There have been improvements in selectivity in Icelandic fisheries in the last century when the mesh size was increased and a real-time closure system was implemented. Further improvements are possible as new fishing gear and technology along with new fishing practises are being developed and tested.

Is there sufficient evidence to support wider adoption of the method/technology?

This simulation study showed that improved selectivity of the fisheries is something that is worth pursuing.

CONCLUSION

The Atlantis modelling framework allows for testing different discarding and selectivity scenarios and to evaluate the impact on the harvested groups but also on non-commercial groups in the system. This study showed that landing all discarded fish did not have much affect when the discard rate is low.

Improving selectivity and avoiding the fish (juveniles) that would usually be discarded had great positive benefits. The biomass and landings increased and the profit from the landings was amplified because the cost per ton decreased with increasing biomass and also the price of the fished increased because larger fish were caught. It can therefore be concluded that selectivity is an important factor which should be improved by developing new fishing gear and adopting new fishing practises.

Annexes

if pertinent

The MINOUW Consortium

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